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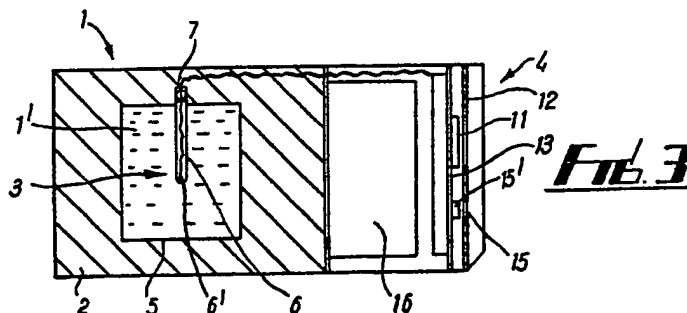
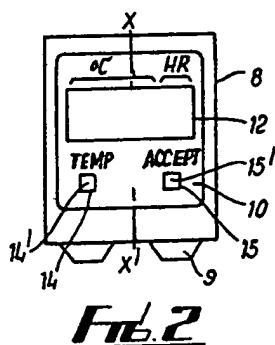
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 N7A1
 G1D DH90
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GB 2164449 A US 4184340 A

(58) Field of search
 UK CL (Edition K) **G1D DH90, G1N NADC NAGA**
 INT CL⁵ **G01K**

(54) A Temperature monitoring apparatus

(57) A temperature monitoring apparatus for monitoring the product temperature of food stuffs comprises a simulator 1, with such insulation 2 so as to be a temperature mid-way between deep temperature and surface temperature of a specific foodstuff (e.g. a chicken), a temperature sensing means 3 and a display means 4. The temperature sensing means is inserted into the simulator which comprises a methyl-cellulose compound 1' in paste form in a spill-proof container 5. The temperature sensed by the temperature sensing means 3 is displayed via a display means 4, said display means portraying and recording both historic and/or current temperature conditions lying outwith pre-selected limits. The apparatus also includes an alarm to indicate that a high or low temperature condition exists or has existed.



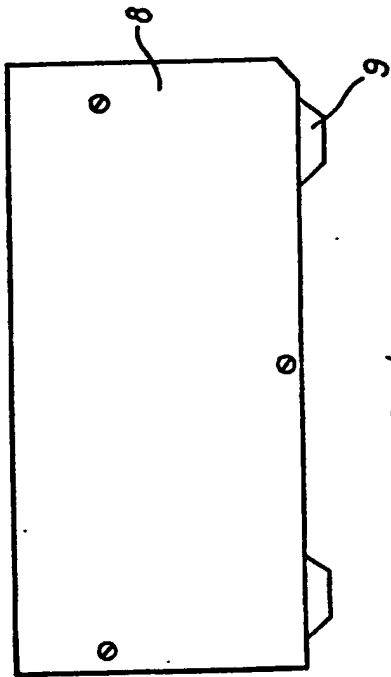


Fig. 1

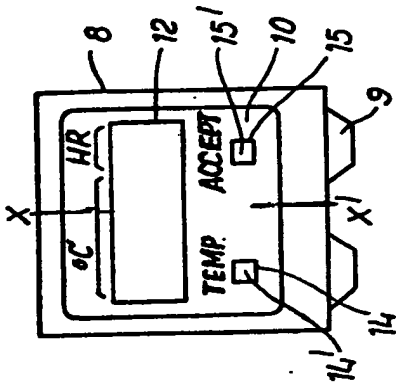


Fig. 2

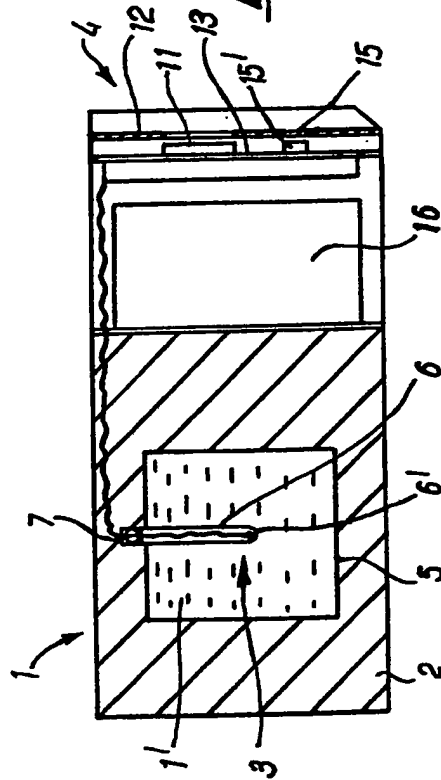


Fig. 3

1 "Temperature Monitoring Apparatus"

2

3 This invention relates to temperature monitoring
4 apparatus, especially but not exclusively for
5 monitoring the temperature of items retained, stored,
6 or displayed in refrigerated cabinets or hot cabinets.

7

8 Conventionally, the temperature of modulated
9 environments has been accessed by sensing air
10 temperature, for example around items of food stored in
11 a display cabinet. The sensors of such systems
12 register the rapid changes in cabinet temperature that
13 can be brought about by, for example, a customer
14 breaking the insulating air curtain during selection of
15 a food item; on registering increase or decrease in
16 temperature, the system activates the chilling or
17 heating means in order that the temperature is
18 corrected to within pre-determined limits.

19

20 However, such systems do not register the temperature
21 of the product stored in the refrigerator, display
22 cabinet or the like. There is increasing public
23 concern, in particular regarding the degradation of
24 biological material and consumables, especially for
25 human consumption, and thus there is increasing demand

1 and need for means to monitor the temperature of the
2 product, and to inform the retailer, customers and the
3 like of any possible harmful condition.

4
5 Hitherto, product temperature has been measured by
6 invasive means (e.g. food probes) which damage the item
7 selected for sampling; since such sampling (to be
8 statistically viable) frequently requires more than one
9 item to be sampled, there is considerable wastage of
10 product. Furthermore, if the probe is removable and
11 sampling (and thus monitoring) is only periodic,
12 significant temperature changes may go unrecorded. If
13 a probe remains permanently in an item, there is a
14 likelihood that the probe, together with the item, will
15 be removed intentionally or unwittingly by a customer.

16
17 According to a first aspect of the present invention
18 there is provided temperature monitoring apparatus for
19 monitoring the temperature of a product, the apparatus
20 comprising a simulator, simulating the product,
21 temperature sensing means to sense the temperature of
22 the simulator, and means to record and display a
23 temperature change outwith a pre-selected temperature
24 range.

25
26 Preferably, the apparatus includes an alarm, whereby
27 the recording of a temperature change outwith the
28 pre-selected range is apparent.

29
30 Preferably, the simulator comprises material whose
31 characteristics under temperature change are similar to
32 a specific product over a specific temperature range.

33
34 Preferably, the simulator comprises a methyl-cellulose
35 compound and an insulating medium therearound; most

1 preferably, the methyl-cellulose compound is in paste
2 form in a plastic spill-proof container having a
3 thermopocket therein for the temperature sensing means.

4
5 The temperature sensing means may be a temperature
6 sensor in the form of a PRT, PRC, or thermistor.

7
8 The display means such as an LCD (liquid crystal
9 display) preferably permits display of current
10 temperature and any historic temperature that lay
11 outwith the pre-selected range; still more preferable,
12 the apparatus is provided with record means to record
13 temperature against time and means to permit authorised
14 users to access the record of the record means.

15
16 The means to permit authorised access to the record or
17 to display information may comprise recessed
18 push-buttons, a first button being for current
19 temperature display and a second being for display of
20 current or historic low or high temperature outwith the
21 range and the time that such low/high temperature was
22 maintained.

23
24 There may be microprocessing means included so as to
25 allow the simulator characteristics to be modified so
26 as to be in accordance with deep or surface product
27 temperature, or so as to permit a catalogue of
28 products, the product from the catalogue being selected
29 via a third recessed push-button.

30
31 According to the present invention there is provided a
32 simulator for a food product, which simulator's
33 characteristics to temperature change are similar to
34 the product over a specific temperature range, the
35 simulator comprising a methyl-cellulose or like

1 compound with insulating medium therearound.

2

3 Although water most closely follows a food product
4 temperature decrease, the latent heat phase in cooling
5 makes water alone unsuitable. The substance, i.e.
6 methyl-cellulose, must be non-toxic, robust and
7 non-leaking.

8

9 Preferably, the depth of methyl-cellulose and thickness
10 of the insulating medium is variable to simulate
11 different products. Chicken, for example, may be
12 selected, as the public associates fowl with food
13 poisoning problems and chicken is conventionally one of
14 the most difficult food items to keep at an optimum
15 temperature.

16

17 According to the second aspect of invention there is
18 provided temperature monitoring apparatus for
19 monitoring the temperature of a product, the apparatus
20 comprising temperature sensing means to sense the
21 temperature of the environs of the product, and means
22 to correct the temperature value sensed in accordance
23 with product type, and means to record and display a
24 change in corrected temperature outwith a pre-selected
25 temperature range for the product type.

26

27 Preferably, the correcting means and the record and
28 display means are associated with, or comprise,
29 micro-processing means, with liquid crystal display
30 (LCD) as the display means.

31

32 Preferably, the temperature readings sensed by the
33 sensing means are fed into the correcting means which
34 is a mathematical model in the form of a algorithmic
35 mathematical thermo-model, the model being adjustable

1 for a range of product types, e.g. dairy, meat,
2 vegetables.

3
4 As the product characteristics in different
5 environmental temperatures and ranges are known (in
6 order to calculate the algorithms) only the environs
7 (e.g. display case air temperature, casing temperature)
8 need be measured for accurate prediction of product
9 temperature; invasive means are not required. The
10 product characteristics for the algorithms may be
11 calculated by a series of preliminary investigations
12 using actual product or using the simulator of the
13 first aspect of the present invention.

14
15 Preferably, the apparatus includes an alarm, whereby
16 the recording of a temperature outwith the pre-selected
17 range is apparent.

18
19 The temperature sensing means may be a temperature
20 sensor in the form of a PRT, PRC, or thermistor.

21
22 The display means such as an LCD preferably permits
23 display of current temperature and any historic
24 temperature that lay outwith the pre-selected range;
25 still more preferable, the apparatus is provided with
26 record means to record temperature against time and
27 means to permit authorised users to access the record
28 of the record means.

29
30 The means to permit authorised access to the record or
31 to display information may comprise recessed
32 push-buttons, a first button being for current
33 temperature display and a second being for display of
34 current or historic low or high temperature outwith the
35 range and the time that such low/high temperature was

1 maintained.

2

3 The recording and/or display means of both the first
4 and the second aspects of the present invention may
5 comprise remote data-logging and display apparatus,
6 which may only be accessible by authorised personnel.
7 The provision of remote data-logging permits the
8 continuous monitoring of a number of display cases, all
9 having product therein.

10

11 The apparatus of both the first and second aspects may
12 be powered by battery or mains and the display means
13 may be integral with the simulator and temperature
14 sensing means, or remote therefrom, and/or a
15 data-logging device is attachable to the simulator by a
16 jack-plug and lead.

17

18 Remote read-out of the information may be achieved by a
19 transmitter and receiver, in the form of a radio pager,
20 to alert personnel.

21

22 Embodiments of the present invention will now be
23 described, by way of example, with reference to the
24 accompanying figures and table, in which:-

25

26 Fig. 1 is a side elevational view of
27 temperature monitoring apparatus
28 according to the present invention;
29 Fig. 2 is a front elevational view of
30 the apparatus of Fig. 1;
31 Fig. 3 is a sectional view of the
32 apparatus of Fig. 2 on line X-X'; and
33 Table I is a schedule of the range of
34 display read-out and push-button
35 operations of the apparatus of Figs.

1 1 to 3.

2

3 Referring to the figures, there is shown temperature
4 monitoring apparatus for monitoring the product
5 temperature of foodstuffs kept in refrigerated display
6 cabinets.

7

8 The illustrated apparatus is particularly suitable for
9 the monitoring of the temperature of foodstuffs in the
10 form of chickens or chicken pieces. The apparatus
11 comprises a simulator, shown generally at 1, of a depth
12 and with such insulation 2 so as to be a temperature
13 mid-way between deep temperature and surface
14 temperature of a chicken.

15

16 The apparatus also includes temperature sensing means,
17 shown generally at 3, and display means, shown
18 generally at 4, to display any temperature change which
19 lies outwith pre-selected limits of a temperature
20 range.

21

22 The simulator 1 comprises a methyl-cellulose compound
23 1' in paste form in a spill-proof container 5, having
24 insulating medium 2 therearound and having a
25 thermopocket 6 therein for insertion of the temperature
26 sensing means 3 in the form of a PRT or PRC or
27 thermistor 6', the junction between the thermistor 6'
28 and its associated leads being a thermal seal 7.

29

30 The simulator 1, thermistor 6 and display means 4 are
31 integral parts of a single unit having an outer
32 metallic casing 8, insulating feet 9, and an apertured
33 front facia panel 10, the apertures being in the form
34 of a window 12 for a LCD 11 (liquid crystal display)
35 attached to a circuit board 13 parallel to and

1 rearwards of the front facia panel 10, and windows
2 14,15 for recessed push-buttons 14',15' being
3 respectively a button 14' for display on the LCD 11 of
4 current temperature, and a button 15' for display of
5 historic (or current) temperature conditions lying
6 outwith the pre-selected limits, and more specifically
7 the temperature in degrees centigrade and number of
8 hours for which the low or high temperature was
9 maintained.

10

11 The push-buttons 14',15' are recessed to prevent
12 unauthorised access, the recesses 14,15 necessitating
13 the insertion of a tool, such as a pen or pencil, to
14 permit operation.

15

16 The electronic components and circuitry comprise the
17 temperature sensing means 3, a sensor analogue
18 amplifier circuit, an analogue to digital circuit and
19 LCD, alarm threshold latch circuits, elapsed alarm time
20 and time counter circuits, and various logic circuits
21 related to display formats and push-button operation.

22

23 The apparatus includes an alarm to indicate that a high
24 or low temperature condition exists or has existed, the
25 alarm being the display of respectively a plus (+) or
26 minus (-) sign on the LCD.

27

28 The various display formats, being both alarm signals
29 and information recorded or monitored by the unit, are
30 shown in Table I, together with the push-button
31 operations required and an explanation of the
32 temperature condition that each display format
33 indicates.

34

35 The illustrated unit is battery 16 operated and this

1 allows for "retro-fit" in existing display cabinets,
2 Other (not shown) embodiments may run from mains power.
3 These and other embodiments (also not shown) may have
4 remote display means, being data-logging devices with
5 display in the form of electronic read-outs or paper
6 read-outs, and preferably with a facility to record
7 changes in temperature against time.

8
9 The apparatus can also be used in hot cabinets,
10 refrigerators and in other environments where knowledge
11 of the temperature of an item therein is important
12 and/or required. For consumables it is imperative that
13 retailers know when food, be it hot or chilled, falls
14 outwith a safe temperature range and for how long. The
15 illustrated embodiment permits a display on the LCD 11
16 of up to 9 hours only of unacceptable temperature
17 conditions. As any retailer would be removing the food
18 from display if the food had been outwith the
19 temperature range for even this length of time, a
20 record of the length of longer periods would not be
21 required in these circumstances.

22
23 The operational features of the shown apparatus are as
24 follows:-

- 25
26 1. The LCD has a resolution of 1/10th of a degree
27 centigrade and a maximum temperature range of -10°C to
28 $+60^{\circ}\text{C}$; (if the display means 4 is remote and connected
29 to the simulator 1, etc., by jackplug and lead, the
30 temperature range is -99.9°C to $+99.9^{\circ}\text{C}$).
- 31
32 2. Accuracy of $\pm 0.5^{\circ}\text{C}$.
- 33
34 3. All display formats as shown on Table I, with built
35 in hours counter to display up to 9 hours, all being

1 only accessible to authorised or trained individuals.

2

3 4. Shelf-standing unit requiring no additional power
4 supply.

5

6 5. The methyl-cellulose does not freeze until a
7 specified sub-zero temperature has been achieved, so
8 that the simulator will continue to fall in
9 temperature, whereas the actual product alongside would
10 pass through a freezing curve (as most food items have
11 a large percentage of their weight as water); this
12 allows the low temperature alarm threshold to be
13 achieved in the simulator in time to save the actual
14 product from freezing (which may, for example, damage
15 nutrients therein or the taste thereof).

16

17 Alternative simulators can be made to be representative
18 of different products and the important relationships
19 (to ensure the correct temperature retention) are
20 between:-

21

22 1) simulator product substance (e.g. methyl-cellulose
23 paste);

24 2) simulator product volume;

25 3) plastic enclosure, both dimension and shape;

26 4) thickness of surrounding insulating medium; and

27 5) material of surrounding insulating medium.

28

29 Methyl-cellulose has been found to be preferable as
30 simulator product substance especially for food in low
31 temperature environments, as it is non-toxic and
32 without a shelf-life restriction. Alternatives include
33 water with glycerol, particularly if it is for a short
34 shelf-life simulator.

35

1 The illustrated embodiment is particularly suitable for
2 use in refrigerated display cabinets or hot food
3 cabinets. Other embodiments are provided with, for
4 example, a handle to be readily portable and permit
5 temperature monitoring, from initial food processing to
6 retail display, including use in non-modulated
7 environments, such as loading bays.

8
9 In other (not illustrated) embodiments, the apparatus
10 is provided with a microchip and microprocessing means;
11 it is possible therewith to select surface or deep
12 temperature monitoring, and/or to select simulation of
13 different products, the menu of products being
14 displayed on the LCD by means of a third push-button
15 recessed mid-way between the existing two push-button
16 apertures.

17
18 In still other (not illustrated) embodiments, the
19 apparatus comprises temperature sensing means to sense
20 the environs (e.g. display cabinet internal air
21 temperature) and means to correct the temperature value
22 sensed, the correction being in accordance with product
23 type. The means for the correcting includes
24 micro-processing means using an algorithmic
25 mathematical thermo-model calibrated for various
26 different products and for those different products
27 over particular environmental temperature ranges such
28 that the temperature sensed is corrected by a factor(s)
29 to generate a value indicative of deep or surface
30 temperature of the product dependent not only on
31 current display case air temperature but also historic
32 display case air temperature. The apparatus also
33 includes means to record and display a change in
34 corrected temperature value if it goes outwith (i.e.
35 above or below) a pre-determined temperature range for

1 product type.

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1 CLAIMS

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3 1 A temperature monitoring apparatus for monitoring
4 the temperature of a product, said apparatus comprising
5 a simulator, temperature sensing means adapted to sense
6 the temperature of the simulator, and means to record
7 and display said temperature.

8

9 2 A temperature monitoring apparatus as claimed in
10 Claim 1, wherein the simulator comprises material whose
11 characteristics under temperature change are similar to
12 a specific product over a specific temperature change.

13

14 3 A temperature monitoring apparatus as claimed in
15 Claim 1 or 2, wherein the simulator comprises a
16 methyl-cellulose compound and an insulating medium
17 therearound.

18

19 4 A temperature monitoring apparatus as claimed in
20 Claim 3, wherein the methyl-cellulose compound is in
21 paste form.

22

23 5 A temperature monitoring apparatus as claimed in
24 any one of the preceding Claims, wherein the apparatus
25 includes micro-processing means adapted to allow the
26 simulated characteristics to be modified in accordance
27 with deep or surface product temperatures, or so as to
28 permit a catalogue of products, and means to select a
29 product from the catalogue.

30

31 6 A temperature monitoring apparatus for monitoring
32 the temperature of a product, comprising temperature
33 sensing means to sense the temperature of the environs
34 of the product, and means to correct the temperature
35 value sensed in accordance with product type, and means

1 to record and display a change in corrected temperature
2 outwith a pre-selected temperature range for the
3 product type.

4
5 7 A temperature monitoring apparatus as claimed in
6 Claim 6, wherein the means to correct the temperature
7 values sensed in accordance with product type, is
8 associated with, or comprises, micro-processing means.

9
10 8 A temperature monitoring apparatus as claimed in
11 Claim 6 or Claim 7, wherein the temperature sensed by
12 the sensing means is fed into the correcting means, and
13 wherein the correcting means is a mathematical model in
14 the form of an algorithmic mathematical thermo-model,
15 the model being adjustable for a range of product
16 types.

17
18 9 A temperature monitoring apparatus as claimed in
19 any of the preceding claims, wherein said apparatus
20 includes an alarm, whereby the recording of a
21 temperature outwith a pre-selected range is apparent.

22
23 10 A temperature monitoring apparatus as claimed in
24 any one of the preceding Claims, wherein the
25 temperature sensing means is a temperature sensitive
26 resistor.

27
28 11 A temperature monitoring apparatus as claimed in
29 any one of the preceding Claims, wherein the means to
30 record and display the temperature records and displays
31 a current temperature and any historic temperature that
32 lay outwith a pre-selected range.

33
34 12 A temperature monitoring apparatus as claimed in
35 any one of the preceding Claims, wherein the means to

1 record the temperature is adapted to record temperature
2 against time.

3

4 13 A temperature monitoring apparatus as claimed in
5 any one of the preceding Claims, wherein the means to
6 record and display the temperature includes a
7 transmitter and receiver whereby the temperature may be
8 known at a remote location.

9

10 14 A temperature monitoring apparatus as claimed in
11 any one of the preceding Claims, wherein the means to
12 record and display the temperature includes means to
13 permit only authorised users to access the recorded
14 information and display.

15

16 15 A temperature monitoring apparatus as claimed in
17 Claim 14, wherein the means to permit authorised users
18 to access the recorded information and display
19 comprises recessed push-buttons, a first button being
20 for current temperature display and a second button
21 being for display of current or historic low or high
22 temperatures outwith the range, and the time that such
23 low or high temperatures were maintained.

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